11.02 SANITARY SEWER MAIN MATERIALS

11.02.01 DESCRIPTION:

1. All materials, equipment, and labor for sewer main construction shall be furnished in accordance with these specifications and in accordance with the Plans prepared by a Registered Professional Engineer licensed to practice in the State of North Carolina.

2. In order to facilitate material selection and reduce confusion on what product(s) meet these specifications, the City of Monroe has produced an approved materials list for components that may be incorporated in the City of Monroe sewer main construction. Where possible, this list contains information for multiple suppliers of approved products. Where there are no approved products listed, such as for sewer main construction components that are unusual or are specific to the project or subdivision, particular information must be provided. Note, only the manufacturer/supplier make and model will be accepted as listed where Approved Equal is not considered. The Water Resources Approved Materials List shall be made available by accessing the City of Monroe website at www.monroenc.org.

11.02.02 SHOP DRAWINGS AND SUBMITTALS:

The City of Monroe shall have the right to request a Formal Submittal or a Subdivision Submittal.

1. Formal Submittal: As a minimum, three (3) copies of the following information shall be submitted to the City of Monroe Water Resources Department for review and approval:
   a. Shop drawings of all items to be fabricated
   b. Catalog cuts
   c. Manufacturer's specifications demonstration compliance with industry standards
   d. Manufacturer's installation recommendation for all items to be used in the works.

2. Subdivision Submittal: As a minimum, a complete list of all items including manufacturer/supplier, size, and model number proposed to be used shall be submitted to the City of Monroe Water Resources Department for review and approval. The Contractor shall reference and complete the form located at the end of this Section.

3. Any materials not listed in the following specifications may require a detailed review by the Water Resources Engineering Manager.

11.02.03 MATERIAL SPECIFICATIONS

The City of Monroe Water Resources Department may supersede the material specifications on any construction project prior to issuance of the Notice to Proceed. Unless superseded or modified in the detailed specifications, all materials, apparatus, supplies methods of manufacture, or construction shall conform to the specifications contained in this Section. National material standards (ASTM, ANSI, AWWA, etc.) referred to herein shall be considered to be the latest revisions only.

SEWER MAIN PIPES

1. SDR-35 PVC: Unless amended on the construction drawings or elsewhere in these specifications, sewer pipe 8-inches through 15-inches in diameter may be Polyvinyl Chloride (PVC) sewer pipe with a Standard Dimension Ratio (SDR) of 35, and shall meet all requirements of ASTM Standards. Sewer pipe 18-inches through 24-inches in diameter may be Polyvinyl Chloride Pipe (PVC) large diameter sewer pipe with a minimum pipe stiffness of 46 PSI in accordance with ASTM Standards. Pipe joining shall be push-on bell and spigots only. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory. The pipe shall be furnished in nominal lengths of 13 feet. PVC sewer pipe shall be green or white in color.

    a. PVC pipe shall contain the markings required by ASTM Standards as applicable. The manufacturer shall submit certification that the pipe has been tested as applicable and has been found to meet all requirements. Test samples shall be as selected by the manufacturer or testing laboratory unless otherwise stipulated in the Special Provision Section of these specifications.

    b. Fittings shall be in accordance with ASTM Standards as applicable, with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

    c. The minimum nominal laying length of the pipe shall be not less than 8 feet for 8" through 24 " pipe and not less than 13 feet for pipe larger than 24". Shorter lengths may be provided where required to maintain manhole location and for providing a flexible joint within two (2) feet of the exterior wall of the manhole.

    d. All PVC Sewer Pipe will be shipped, stored, and strung at the project in such a manner as to be protected from accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks at the job site.

2. Sewer Rated Ductile Iron Pipe: Ductile iron pipe shall conform to the requirements of AWWA Standards and shall have an epoxy or lafarge calcium

aluminates lining approved by manufacturer for sewer usage. Unless otherwise shown on the construction plans, all ductile iron shall be furnished with push joints in accordance with AWWA Standards.

a. Twelve (12) inch and smaller diameter pipe shall be a **minimum** Pressure Class 350. Pipe greater then Twelve (12) inches in diameter shall be a **minimum** Pressure Class 250 and selection shall be based on the installation conditions. This pipe class shall be as shown on the plans or elsewhere in these specifications.

i. Push-On Joint Material: Gaskets for push-on pipe shall be furnished by the pipe manufacturer. Gaskets and gasket lubricant shall meet the requirements of ANSI Standards.

3. Polyvinyl Chloride (PVC C900 DR-25) Pipe: Unless amended on the Construction Drawings or elsewhere in these specifications, sewer main pipes may be constructed in accordance with AWWA C-900 DR-25. The pipe shall have a minimum Pressure Class of 165 PSI. PVC Pressure Pipe shall be made from white or blue pigmented virgin materials and shall be furnished in lengths of 20 feet. Shorter lengths may be provided where required to maintain manhole location and for providing a flexible joint within two (2) feet of the exterior wall of the manhole. All PVC Sewer Pipe will be shipped, stored, and strung at the project in such a manner as to be protected from accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks at the job site.

a. Push on Joint: Pipe joints will be by elastomeric joints only. Joints shall conform to AWWA standards for 8-inch through 18-inch pipe.

b. Pipe bells, with gasket seats, shall be formed as the pipe is extruded. Sleeve couplings are not permitted except as necessary for repairs of existing mains or as necessary for the employment of pressure/leakage testing.

TRACER WIRE AND NON-DETECTABLE LOCATOR TAPE

1. Tracer wire shall be 12-gauge minimum stranded copper with thermoplastic insulation for direct burial. Tracer wire will only be required on force mains or low pressure sanitary sewers.

2. Non-metallic, non-detectable locator tape shall be installed 2-feet above the top of all gravity sanitary sewer mains, along its entire run. For force mains, the tape shall be installed 1-foot below final grade. The tape shall be 3-inches in width, green, and marked “Buried Sewer.”

4-INCH SANITARY SEWER LATERALS:

1. All 4-inch laterals shall be Schedule 40 PVC or Sewer Rated DIP laterals. Four inch laterals may connect at manholes or to the sewer main.

   a. Schedule 40 PVC: Schedule 40 PVC laterals shall be in accordance with ASTM Standards. Fittings shall be socket type in accordance with ASTM Standards. Joining shall be through solvent cement in accordance with ASTM Standards.

   b. Ductile Iron Pipe: 4-inch shall be in accordance with the specifications listed for sewer main pipe above.

6-INCH THROUGH 12-INCH SANITARY SEWER LATERALS:

1. All 6-inch through 12-inch sanitary sewer laterals shall be SDR 35 Polyvinyl Chloride Pipe, Schedule 40 PVC or Sewer Rated DIP as herein before specified.

COUPLINGS/ SADDLES:

1. Couplings for 12-inch and smaller pipe may also be elastomeric PVC with internally molded rigid fiberglass insert and stainless steel bands.

2. Couplings for 15-inch and larger pipe shall be submitted to the Water Resources Engineer for approval.

3. Saddles for lateral connections into existing mains shall be constructed of a ductile iron body, fusion bonded epoxy coated for corrosion resistant, and a single type 304 stainless steel strap. All hardware shall be type 304 stainless steel.

MANHOLES

1. All sewer manholes shall be constructed of precast concrete sections in conformance with the following specifications and City of Monroe Standard Detail Drawings. Special cast in place manhole structures shall be as shown on the plans and shall comply with the applicable sections in these specifications.

2. Manholes shall be furnished with pre-cast bottom slabs and flexible watertight boots for 15-inch and smaller pipe. The boots shall be cast in as integral parts of the base or installed in cored openings with stainless steel compression bands, and shall conform to ASTM Standards. Manholes for 18-inch and larger pipe may be furnished with precast bottom slabs and flexible boots, flexible seals, or concrete collars. Flexible connectors shall conform to ASTM Standards. The concrete collars shall be according to the applicable Standard Detail. Manholes to be placed over existing pipelines shall be furnished with “doghouse” openings cast in the bottom section allowing it to be set over the existing pipe. A concrete base and invert shall be poured around the bottom section and the pipe according to the **Standard Detail 12.04.00** of these Specifications.

3. Shop drawings, which show dimensions, openings for pipe, reinforcing steel dimensions and layout and other essential details shall be submitted for approval.

4. Precast Reinforced Concrete Manhole Sections: All precast reinforced concrete manholes shall conform to the City of Monroe Standard Detail drawings and to ASTM Standards. The following minimum standards shall also apply:

   a. Wall thickness shall be 1/12th of the inside diameter with a minimum thickness of five (5") inches.

   b. Base sections shall be cast monolithically or have a waterstop cast in the cold joint between the walls and the base slab.

   c. Cone sections shall normally be eccentric with the inside face of one side vertical and flush with the inside face of the barrel section. Eccentric cones with bolt down frame and cover shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32 inches. Eccentric cones with bolt down frame and cover to be installed flush to finish grade may have a minimum vertical height of 24-inches. Concentric cones with a vertical height of 20-inches may be used on manholes less than five (5') feet deep (4' diameter manhole only). Transition cone sections may be provided for an eccentric transition from a 60-inch riser to a 48-inch cone section to be placed directly beneath the 48-inch cone.

   d. Transition slabs may be placed a minimum of five (5) feet above the invert shelf for six (6) feet and larger diameter manholes where the slab will be buried.

   e. Joints between sections shall be manufactured in accordance with ASTM Standards. Joints shall be sealed with rubber gaskets in accordance with ASTM Standards or with butyl rubber seals conforming to Federal Specifications and AASHTO Standards.

   f. All markings required by ASTM Standards shall be clearly stamped on the inside of each section.

   g. Aggregate shall be sound, crushed, angular granitic stone only, in accordance with ASTM Standards, except that the requirement for graduation in that standard shall not apply. Smooth or rounded stone (river rock) shall not be acceptable.

   h. The cement shall be Type II with a maximum tricalcium aluminate ($3CaOAl_2O_3$) content of 8%.

i. Manhole riser sections, transition slabs, and cone sections shall be designed for H-20 loadings.

j. The manufacturer may be required to furnish the Water Resources Engineer with test results on compression and absorption for one section in every twenty-five sections poured, and certification from cement manufacturer and aggregate supplier certifying chemical content. The Engineer reserves the right to pick random sections for the required testing.

k. The manufacturer shall provide to the Water Resources Engineer a letter certifying that 10% of the manholes to be used on the project have successfully passed a Vacuum Test prior to shipment. Vacuum testing shall be in accordance with Division 3 Testing of these specifications.

5. Steps: Manhole steps shall be steel reinforced co-polymer polypropylene, and shall be placed in the forms while the manhole barrel and cone sections are being cast. Materials and manufacturer shall meet the standards and requirements as set forth in ASTM and AASHTO.

6. Grade Adjustment: All adjustment to the manholes shall be done with concrete grade rings. A maximum grade adjustment of all manholes with concrete grade rings shall be 12". Total adjustment from the top of the cone shall not exceed 21" including the ring and lid. All manhole cast iron rings shall be bolted into the manhole cone through the concrete grade ring with ½" diameter kwik bolt stub anchor system. The outside of the adjusting rings from casting to cone shall be coated with an approved watertight plug.

7. Manhole Inserts: All new manholes (not including cross country manholes), for mains 12-inches or less, shall be furnished with a manhole insert, manufactured from high density polyethylene copolymer material, to capture inflow waters from entering the sewer system.

8. Manhole Liners: Where indicated on the plans or elsewhere in these specifications, manholes shall be furnished with a liner for resistance to corrosive sewers. Manhole liner material shall be submitted by the Project Engineer and shall be approved by the Water Resources Engineer after examination and on a case by case basis.

MANHOLE RINGS AND COVER

1. All castings shall be manufactured in the United States of America. All manufacturers shall be approved suppliers and be able to demonstrate that there is an acceptable quality control program at the producing foundry, prior to supplying castings.

a. Materials: Gray iron and Ductile Iron castings shall be manufactured from iron conforming to ASTM Standards. The iron material used in products provided shall have a minimum recycled material content of 75%. The recycled materials shall consist of post-consumer materials.

b. Manufacture: Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects. Castings shall be ground smooth and well cleaned by shot blasting. For traffic service castings, bearing surfaces between manhole rings and covers shall be cast or machined with such precision to prevent rocking. As cast dimensions may vary within acceptable foundry tolerances as outlined in the Iron Castings Handbook published by the American Foundry Society, Inc. Nominally, casting dimensional tolerances shall be +/- 1/16" per foot. All published casting weights are average and approximate values and shall vary +/- 5%. Castings shall be furnished painted or unpainted as specified by the purchaser.

2. Manhole ring and covers shall be furnished with the common contact surfaces between frame and cover machined.

3. Frame and cover shall be free of sand holes, no plugging permitted. Two vent holes shall be provided on the top of the manhole cover except where plans require a "water tight lid" or the City specifies otherwise. Frame shall include 4 drilled holes for expansion anchors through the manhole cone.

4. Where watertight frames and covers are specified, the watertight seal between frame and cover shall be accomplished by means of an o-ring rubber gasket.

5. Swivel Castings shall be used on all cross country manholes.

STEEL VENT PIPES

1. Steel Vent Pipe: Unless otherwise specified, steel vents shall be Schedule 40, five inch (5") diameter steel pipe, consisting of Grade "B" steel as specified in ASTM Standards.

a. All steel shall be Grade "B" only, with a minimum yield strength of 35,000 P.S.I.

b. The steel pipe shall have an inside coal tar lining 3/32 inch minimum thickness in accordance with AWWA Standards or a coal tar epoxy lining conforming to that required for steel (aerial creek crossing) pipe.

c. Outside surface of pipe shall be sand or grit blasted to commercial standard and have one (1) coat of zinc chromate primer applied in accordance with Federal Specifications.

d. Pipe shall be furnished with two (2) evenly applied coats of rust inhibiting enamel paint. Color shall be sewer green.

STEEL ENCASEMENT

1. Steel Encasement Pipe: Steel pipe shall be welded or seamless, smooth wall or spiral weld, consisting of Grade "B" steel as specified in ASTM Standards.

   a. Minimum yield strength shall be 35,000 PSI; and pipe thickness shall be as specified for each individual job.

   b. All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.

   c. Encasement pipe must be approved by the appropriate controlling agency (D.O.T., R.R., etc.) and the Engineer prior to ordering.

AERIAL CROSSINGS (DIP, ANCHORS AND STRAPS)

1. Aerial Crossings shall not be placed lower than the 25 year flood elevation.

   a. Pipe: Shall be ductile iron flanged pipe conforming to the requirements of AWWA Standards and drilling and facing of flanges shall be in accordance with ANSI Class 125 Standards. All nuts, bolts, and washers shall conform to ANSI and ASTM Standards and shall be type 304 stainless steel or high strength, low alloy steel. All exposed surfaces shall be coated with an approved coating system that satisfies the Water Resources Engineering Manager.

   b. Concrete Piers: Concrete piers shall be constructed in accordance with the Concrete Specifications contained in these Specifications and **Standard Detail 12.12.00**

   c. Steel Straps And Anchors: All pipe and/or pier straps shall be stainless steel. Anchor bolts (non-head) shall conform to ASTM standards with tension test to be made (as required) on the bolt body or on the bar stock used for making the anchor bolts. Unless otherwise specified all other fasteners shall conform to ASTM standards for carbon steel externally and internally threaded standard fasteners Grade A or B.

CONCRETE

1. Portland Cement: All concrete shall conform to the Standard Specifications for Ready Mixed Concrete. An air-entraining admixture, conforming to ASTM standards, shall be added to either Type I, Type II, or Type III Portland Cement.

Fly Ash conforming to ASTM standards for Class C Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 10% of the cement therein (strengths shall not be less than hereinafter required).

a. Types I, IA, III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer, and shall conform to ASTM Standards.

b. Types II and IIA Portland Cement shall be used in pre-cast manholes, cast in place manhole structures, reinforced concrete pipe, reinforced concrete piers and concrete or reinforced concrete rip-rap as directed by the Engineer, and shall conform to ASTM Standards except that Tri-calcium Aluminate ($3CaOAI_20_3$) content shall not exceed 8%.

2. Aggregates: All aggregates used for concrete shall conform to ASTM standards and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.

a. Coarse Aggregates: Shall be uniformly and evenly graded for each application. Unless otherwise approved, aggregate shall be sound, crushed, angular granite stone. Smooth or rounded stone (river rock) shall not be acceptable.

b. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in the standard except that the percent passing a No. 50 sieve shall not exceed 5% and the percent passing a No. 100 sieve shall be 0% as provided for in the standard.

3. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, and workable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM standard with the exception of the use of calcium chloride, which shall be limited to no more than 1 % by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride will be allowed.

a. The Contractor shall assume responsibility for concrete mixture. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to pre-cast manhole or reinforced concrete pipe).

i. Compressive Strength Minimum 3600 PSI
ii. Water-Cement Ratio By Weight Maximum-0.50
iii. Slump Min. 3", Max. 5"

iv. Air Content (Entrained &Entrapped) Min. 4% Max. 6%
v. Coarse Aggregate 3/4"-1 ½" (as required by the application)

b. When required by the Water Resources Engineer, and prior to beginning construction, the Contractor, at his expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with his list of materials and material suppliers for approval.

4. Curing Compound: Immediately following trowel finish in a non-yellowing compound for curing, sealing, hardening and dustproofing concrete slab surfaces shall be applied as specified. It shall be formulated to meet or exceed ASTM C309.

a. Curing compounds shall be applied as forms are stripped.

6. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement.

a. Acceptable range of testing requirements:

i. Compressive Strength: 10,500 to 12,500 PSI
ii. Bond Strength: 1,350 to 1,700 PSI
iii. % Expansion: +.025% to +0.75%

b. Expansion grouts shall be used only as directed by the Water Resources Engineer.

c. Grout shall be mixed (if Applicable) and placed in accordance with the manufacturer's current recommendations, for each specific application.

6. Mortar: Type M.

7. Steel Reinforcing for Concrete

a. Bars: Provide Grade 60 for Bars No. 3 to 18, except as otherwise indicated per ASTM A615.

b. Wire: ASTM A185 and ASTM A82

STONE

1. Granular Bedding Material: All bedding material shall be angular, clean washed crushed stone graded in accordance with NCDOT No. 67 in ASTM Standards

for "Standard Sizes of Coarse Aggregate." Bedding material will be used only as instructed in the Specifications and/or as specifically directed by the Water Resources Engineer.

2. Stone Stabilization Material: All stone stabilization material shall be angular, clean washed crushed stone graded in accordance NCDOT No. 467M.

3. Silt Check Dam Material: Shall be coarse angular, clean washed crushed stone, gravel, or rock, well graded, and ranging in size from 2-inches to 6-inches, (NCDOT stone for erosion control-Class A).

4. Rip Rap: All rip rap shall consist of clean field stone or rough unhewn quarry stone, resistant to the action of air and water, varying in weight from 25 to 250 pounds with 60% weighing a minimum of 100 pounds each and no more than 5% weighing less than 50 pounds each, (NCDOT Class 2 Rip Rap). Rip rap will be placed from a minimum of 4.0 feet below the toe of the bank to top of the bank in areas determined by field conditions. Rip rap thickness shall be 1 1/2 times the diameter of the largest stones used, or 2.0 feet, whichever is greater.

Shop Drawings Materials List

Necessary Materials for a Sewer Main Extension. (If not applicable to the specific project omit from the form)

Project Name:_____
Form Submitted By:_____

Supplier:_____
Address:_____
Supplier Contact Person:_____
Phone Number:_____

MATERIALS	MANUFACTURER	MODEL #	SIZE
Pipe Class SDR-35 PVC			
Sewer Rated Pipe Class 350 DIP			
Pipe C900 DR-25 PVC			
Standard Sewer Main Fittings and Couplings			
Pre-Cast Manholes			
Manhole Ring and Cover			
Service Lateral Pipe and Fittings			
Manhole Seals			
Manhole Steps			
Butyl Rubber Joint Sealant			
Manhole Insert			
Concrete Grade Rings			
1/2" Diameter Kwik Bolt Anchor System			
Manufacturer Certification Letter (Manholes)			
Grouts			

Approved By City of Monroe ***Date***